Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1.-71. (Cancelled)

72.(Original) A method for synthesizing a polysaccharide backbone for heparin, heparan sulfate and related compounds, the method comprising contacting an acceptor saccharide that comprises a terminal glucuronic acid or GlcNAc residue with a reaction mixture that comprises:

a microorganism or plant cell that comprises:

a) an enzymatic system for forming UDP-GlcNAc; and

b) a recombinant GlcNAc transferase that catalyzes the transfer of GlcNAc from the UDP-GlcNAc to a terminal glucuronic acid on the acceptor saccharide to produce an acceptor saccharide that comprises a terminal GlcNAc residue; and

a microorganism or plant cell that comprises:

a) an enzymatic system for forming UDP-glucuronic acid; and

b) a recombinant glucuronic acid transferase that catalyzes the transfer of glucuronic acid from the UDP-glucuronic acid to a terminal GlcNAc residue on the acceptor saccharide to produce an acceptor saccharide that comprises a terminal glucuronic acid residue; and

allowing the reaction to proceed until the polysaccharide backbone is synthesized.

73.(Original) The method of claim 72, wherein the reaction mixture comprises a single cell type that comprises:

a) enzymatic systems for forming UDP-GlcNAc and UDP-glucuronic acid;

b) a recombinant GlcNAc transferase; and

c) a recombinant glucuronic acid transferase.

74.(Original) The method of claim 72, wherein the enzymatic system for forming UDP-GlcNAc and the recombinant GlcNAc transferase are in a first cell type, and the enzymatic system for forming UDP-glucuronic acid and the recombinant glucuronic acid transferase are in a second cell type.

75. (Original) The method of claim 72, wherein either or both of the enzymatic systems for producing UDP-GlcNAc and UDP-glucuronic acid comprises a full or partial sugar nucleotide regeneration cycle.

76. (Original) A method for synthesizing heparin, heparan sulfate and related compounds, the method comprising contacting a heparan polysaccharide backbone with a reaction mixture that comprises a microorganism or plant cell which comprises:

a) an enzymatic system for forming PAPS; and

b) a recombinant sulfotransferase which catalyzes the transfer of a sulfate from the PAPS to the heparan polysaccharide backbone to produce an N-sulfated polysaccharide.

77. (Original) The method of claim 76, wherein the enzymatic system for forming PAPS comprises a PAPS cycle.

78. (Original) The method of claim 76, wherein the method further comprises contacting the N-sulfated polysaccharide with a glucuronic acid 5'-epimerase to convert one or more glucuronic acid residues in the polysaccharide backbone to iduronic acid.

79. (Original) The method of claim 78, wherein the glucuronic acid 5'-epimerase is expressed by a cell present in the reaction mixture that comprises a gene that encodes glucuronic acid 5'-epimerase.

80. (Original) The method of claim 78, wherein the method further comprises contacting the iduronic acid-containing N-sulfated polysaccharide with one or more O-sulfotransferases to form heparan sulfate.

81. (Original) The method of claim 80, wherein the O-sulfotransferase is expressed by a cell present in the reaction mixture that comprises a gene that encodes the O-sulfotransferase.

82. (Original) The method of claim 81, wherein the cell that expresses the O-sulfotransferase further comprises an enzymatic system for forming PAPS.

83. (Original) The method of claim 76, wherein the heparan polysaccharide backbone is obtained by a method that comprises:

contacting an acceptor saccharide that comprises a terminal glucuronic acid or GlcNAc residue with a reaction mixture that comprises:

1) a microorganism or plant cell that comprises:

a) an enzymatic system for forming UDP-GlcNAc; and

b) a recombinant GlcNAc transferase that catalyzes the transfer of GlcNAc from the UDP-GlcNAc to a terminal glucuronic acid on the acceptor saccharide to produce an acceptor saccharide that comprises a terminal GlcNAc residue; and

2) a microorganism or plant cell that comprises:

a) an enzymatic system for forming UDP-glucuronic acid; and

b) a recombinant glucuronic acid transferase that catalyzes the transfer of glucuronic acid from the UDP-glucuronic acid to a terminal GlcNAc residue on the acceptor saccharide to produce an acceptor saccharide that comprises a terminal glucuronic acid residue; and

allowing the reaction to proceed until the polysaccharide backbone is synthesized.

84.(Original) The method of claim 72, wherein the method further comprises sulfating a heparan polysaccharide backbone to form an N-sulfated heparan polysaccharide backbone.

85.(Original) The method of claim 84, wherein the method further comprises contacting the N-sulfated polysaccharide with a glucuronic acid 5'-epimerase to convert one or more glucuronic acid residues in the polysaccharide backbone to iduronic acid.

86.(Original) The method of claim 85, wherein the method further comprises contacting the iduronic acid-containing N-sulfated polysaccharide with one or more O-sulfotransferases to form heparan sulfate.

87.-105. (Cancelled)